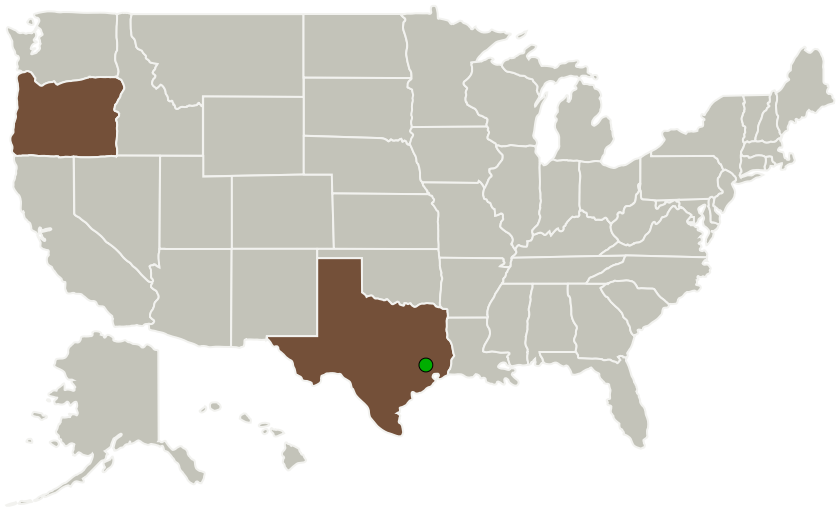
High Efficiency Microchannel Sabatier Reactor System for In Situ Resource Utilization, Phase I

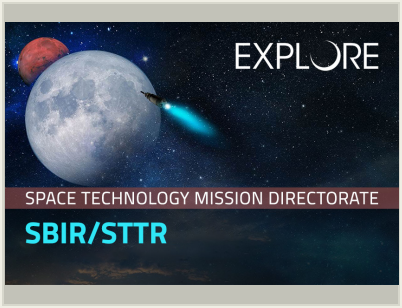
Completed Technology Project (2012 - 2012)

Project Introduction

An innovative Microchannel Sabatier Reactor System (MSRS) is proposed for 100% recovery of oxygen (as water) and methane from carbon dioxide (CO2), a valuable in situ resource available in the atmosphere or as frozen deposits on Mars and other Near Earth Objects (NEOs), using hydrogen. The Sabatier reaction will greatly benefit from inherently superior microreactor heat and mass transfer characteristics compared to conventional reactor designs. Significantly, multiple microreactors can readily be configured in series or parallel arrangements that improve reaction outcomes, and process scale up is easily achieved by numbering up mass produced microreactors. High conversion rates will require the deposition of highly active, supported catalyst layers onto microchannel walls that enhance surface area, adsorption characteristics, and catalyst effectiveness factor. Another research focus area will be a MSRS design that optimizes residence time, thermal recovery, and the achievement of equilibrium at low temperature. Successful completion of the Phase I project will provide microreactor performance data required to design and assemble a first generation MSRS. The Phase II research will result in the development of a prototype MSRS incorporating integrated sequential microreactors and heat exchange with the capability of processing 1 kg hr-1 of CO2. The prototype MSRS will clearly demonstrate the efficacy of this in situ resource utilization approach.

Primary U.S. Work Locations and Key Partners





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Organizations Performing Work	Role	Type	Location
UMPQUA Research Company	Lead Organization	Industry	Myrtle Creek, Oregon
Johnson Space Center(JSC)	Supporting Organization	NASA Center	Houston, Texas

Primary U.S. Work Locations	
Oregon	Texas

Project Transitions

February 2012: Project Start

August 2012: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/138193)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

UMPQUA Research Company

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

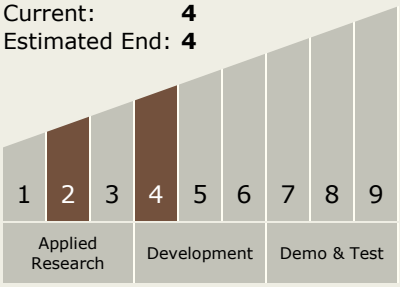
Carlos Torrez

Principal Investigator:

James R Akse

Technology Maturity (TRL)

Start: **2**
Current: **4**
Estimated End: **4**



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Technology Areas

Primary:

- TX07 Exploration Destination Systems
  - TX07.1 In-Situ Resource Utilization
    - TX07.1.3 Resource Processing for Production of Mission Consumables

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System